Need of B-Field Data for Tevatron

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Beam Phenomena of Concern

Time varying magnetic fields may result in :

- b_0 variation — orbits, tunes (via chromaticities)
  - Trouble scale: 0.5-1mm, 0.001-0.002
  - Observed: 0.2-0.6mm (may be GM), +-0.001
- (a,b)_1 — tune+coupling drifts
  - Trouble scale: 0.001-0.002
  - Observed: +-0.01-0.02 at 150 (comps'd), +-0.001 at LB
- (a,b)_2 — chromaticity; differential tunes+coupling
  - Trouble scale: 1-2 units in C_v,h; 0.001-0.002 in Q, Q-split
  - Observed: C_v,h ~30 on ramp (snapback, compens'd to 2-3??)
    C_v.h ~30 at 150 (compens'd to 2-3), ?? At LB,
- (a,b)_3,4 — differential chromaticities, DA
  - Trouble scale: ~ 2 units in C_v,h
  - Observed: 4-6 units, ?? in DA
- HF fluctuations — longitudinal and transverse emittance growth
  - Trouble scale: dB/B ~ (1-5)e-6 at 35Hz, 2e-10 at 20kHz
  - Observed: ??

Related Operational Problems

- In the past
  - Tune, coupling and chromaticity drifts at 150 → compensation
  - B2 snapback → compensation
- In the future:
  - ??

Comments :

- A year ago or so:
  - uncertainties of what are major factors affecting time dependencies (flat-top, number of precycles, front-porch, back-porch, quench, etc)
  - clear trend to higher beam intensities → higher sensitivity to losses
  - All that led to desire to have an "on-line" system which reports (a,b)_0,1,2,3,4 to ACNET for us to be able to correlate them with beam parameters … then compensate
- TD was "sort-of" reluctant to jump on system:
  - Magnets were found too "individual"
  - The system requirements too tough (reliability, availability, etc)
  - off-line measurements were progressing fast

Is situation different now?

- Tev efficiencies greatly improved (slide)
- TD delivered new results on b2
- But:
  - do other components behave the same way?
  - scales of the (a,b)_n variations are not know for all n=0..4
  - intensities will continue to grow (p'sx1.2, pbar'sx6)
- would "on-line" system still be reasonable?
  - That's question to this meeting

Tevatron Progress

	03/02	10/02	03/03	09/03	$\bar{p}$/p only
Record Luminosity, e30	12	36	41	50	~n/a
Protons/bunch	140e9	170e9	205e9	245e9	same
Pbars/bunch	7.5e9	22e9	23e9	25e9	same
P-loss at 150 GeV	23%	14%	10%	8%	8%
Pbar-loss at 150	20%	9%	4%	2%	2%
P-loss on ramp	7%	6%	5%	5%	3% *
Pbar-loss on ramp	14%	8%	11%	8%	2%
Pbar-loss in squeeze	25%	5%	2%	3%	0%
Pbar lifetime at HEP, hr	~20	~40	~35	~35	~900
Proton lifetime at HEP, hr	~400	~90	~60	~20	~300 *

Significant progress → Need anything else?

Breakthroughs - in Physics & Technology

▪ "Sequence 13" fixed (larger helix separation in squeeze)	Tev	x 1.40
▪ "New-new" injection helix (better helix separation at injection)	Tev	x 1.15
▪ "Shot lattice" (lattice changed to reduce IBS)	AA	x 1.40
▪ Pbar emittance at injection (inj steering errors reduced by BLT)	Tev/Lines	x 1.20
▪ Pbar coalescing improvement (smaller longitudinal emittance)	MI	x 1.10
▪ C0 Lambertsons Removed /Dampers (Z_T reduced, N_p increased)	TeV	x 1.25
▪ S6 cuircuit tuned/SEMs removed (differential C_v,h, emittance blowup fixed)	TeV/Lines	x 1.10
	total	x 4.1